Task K Report

Status of Tevatron and the DØ Experiment
UM/DØ Group Personnel and Responsibilities
DØ Computing & Software

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DOE review of Task K, September 9, 2002

Tevatron & DØ Status

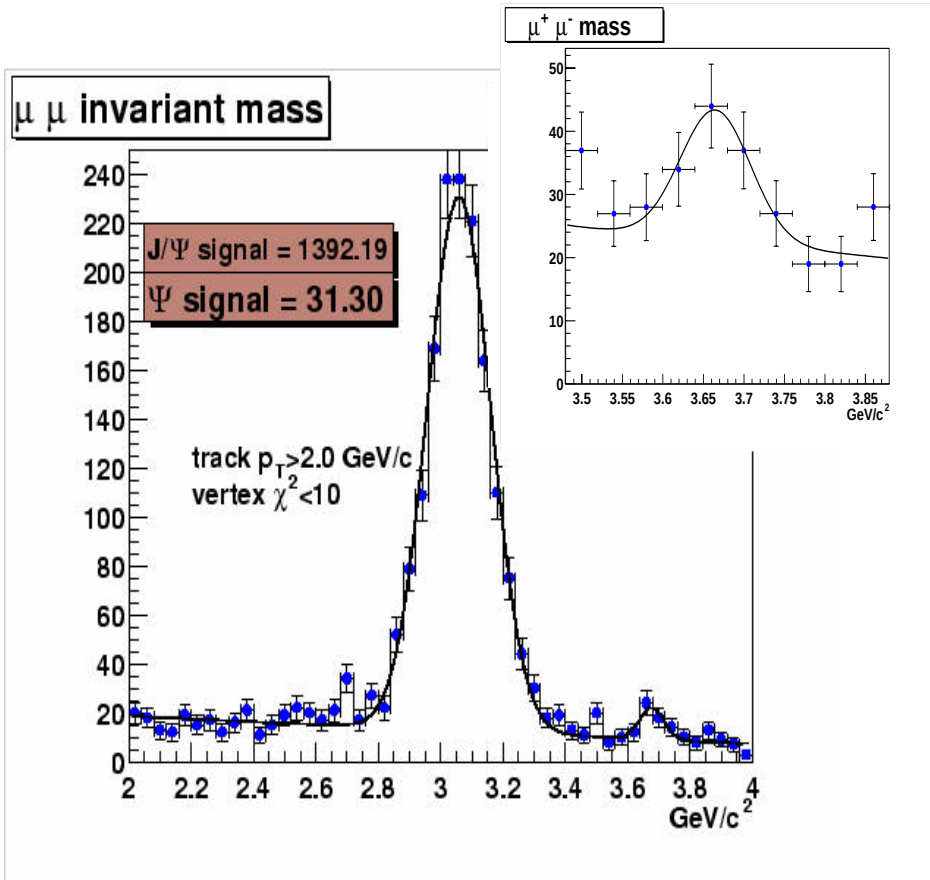
Tevatron

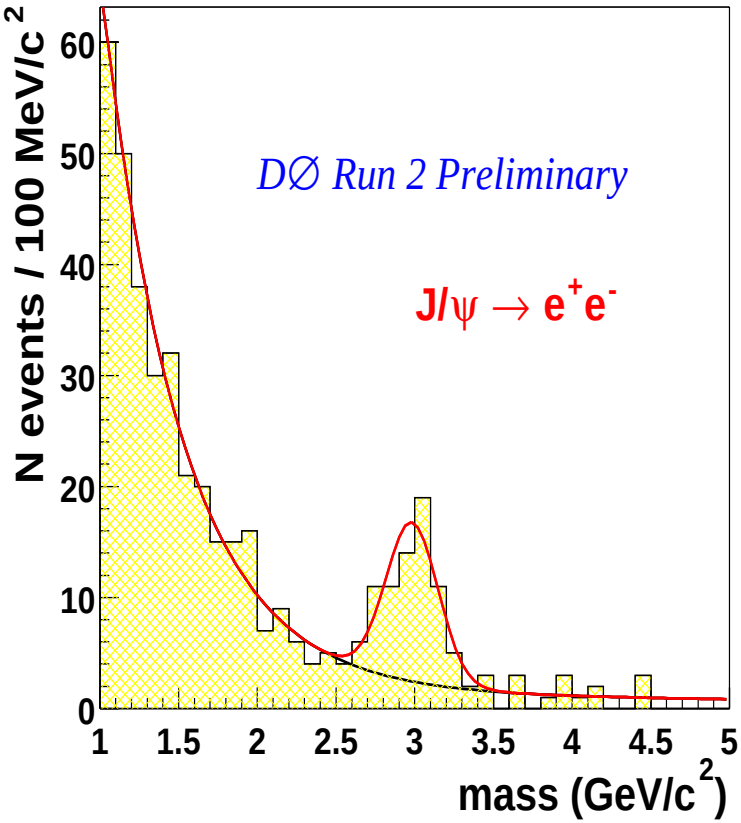
- Luminosity problem persist (transferring, emittance, ...)
- Maximum instantaneous luminosity ~2.5E31, long way to go to achieve the designed lumi of 2E32
- Weekly delivered luminosity 4-5 pb^{-1}

DØ

- All Run IIa detector systems operational
- DAQ efficiency ~65%, work on improvement
- Several trigger systems remain to be commissioned
- Focus on calibration, reconstruction and data processing
- Beginning to produce first Run II physics results
- Run IIb upgrade has the stage I approval

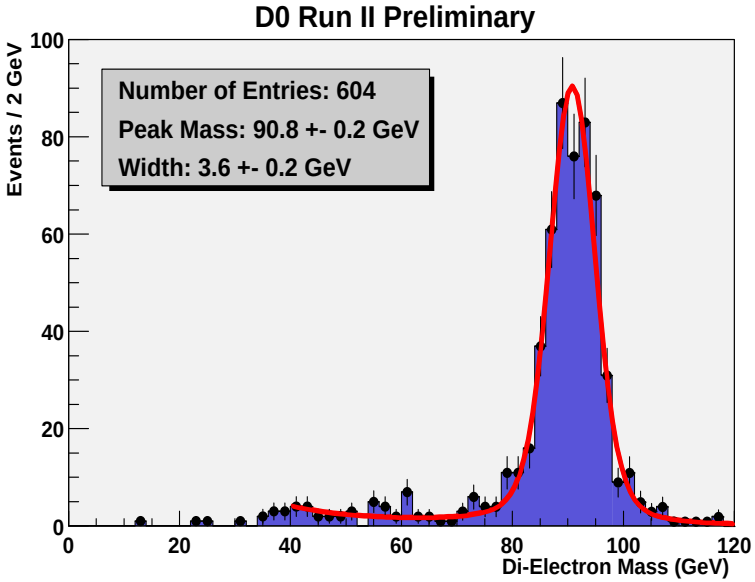
J/ψ Reconstruction



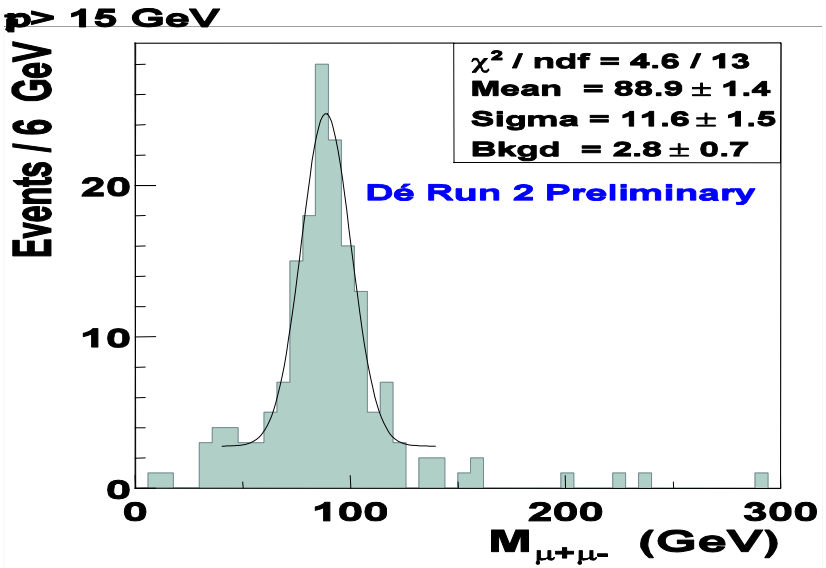


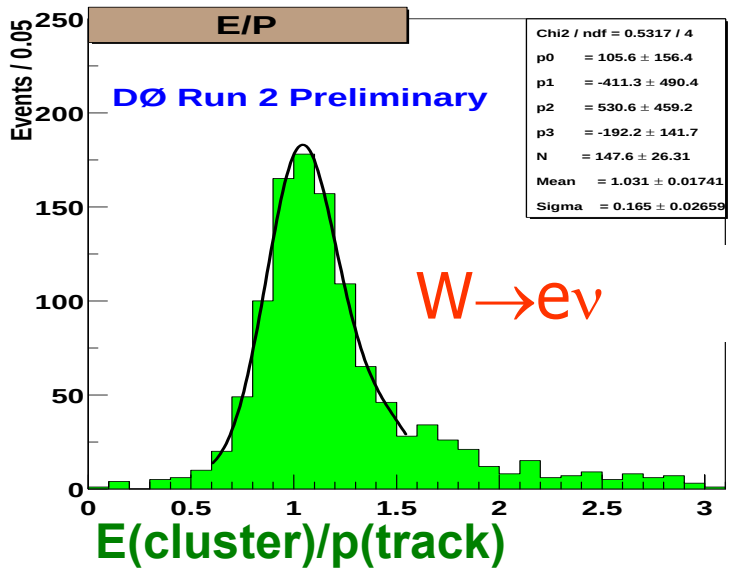
- **reconstructing ψ→μμ for the first time**
- **reconstructing ψ→ee for the first time at hadron colliders?**

W/Z Reconstruction

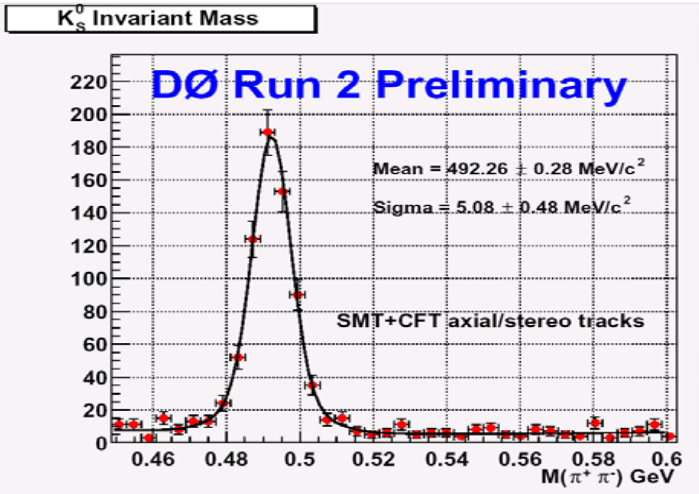


- **improved muon momentum resolution**
- **E/p for electrons to improve identification**

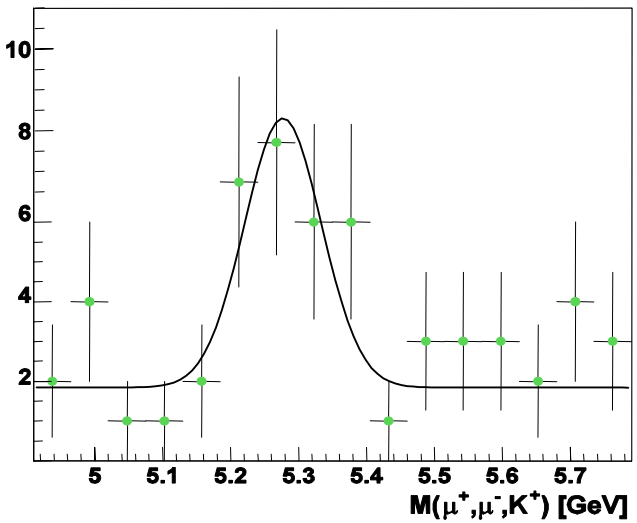




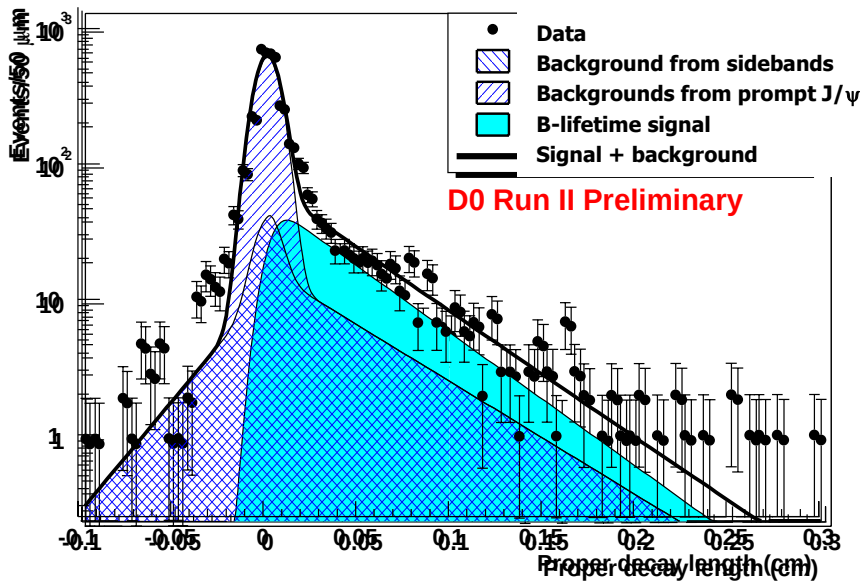
B Physics & b Tag



- resonance reconstructions through their decays to charged particles
- b-quark tagging through secondary vertices and impact parameters



Proper B decay length (B →J/ψ+X)



Michigan DØ Group

Primary Responsibilities

- Commission and operation of the fiber tracker and the central preshower detector
- Coordinate DØ computing and software effort

Faculty

• Jianming Qian	Co-leader, Computing & Software
• Homer Neal	Calibration database, remote processing
• Bing Zhou	Fast muon MC program, local linux cluster

Research physicists

• Andrew Alton	Fiber tracker/Preshower operation
• Yi Jiang	Central preshower software, calibration
• Zhengguo Zhao	Preshower Level 2 firmware

Graduate Students

• Chunhui Han	Measurement of ttbar cross section
• James Degenhardt	new student

Two New Ph.D.s

Dr. Qichun Xu

The Direct Measurement of W Boson Decay Width at DØ

December 2001

Advisor: Bing Zhou

Dr. Xu is now a postdoc with Michigan ATLAS project, but continue working on Preshower Level-2 trigger firmware

Dr. Yimei Huang

Measurement of Top Quark Mass using Kinematic Variables

May 2002

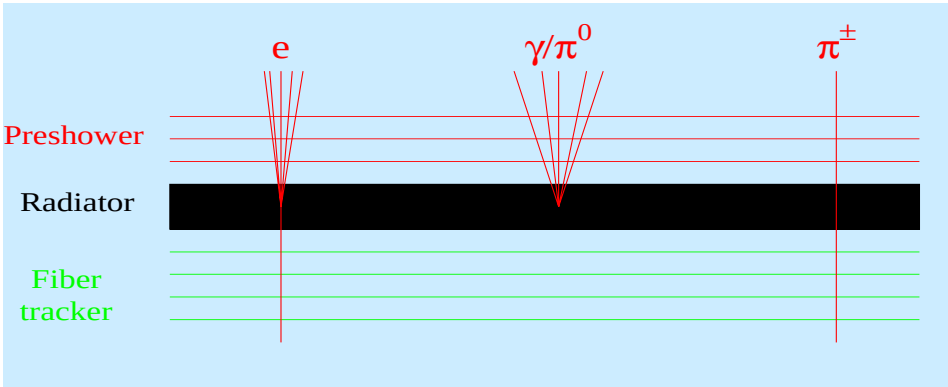
Advisor: Jianming Qian

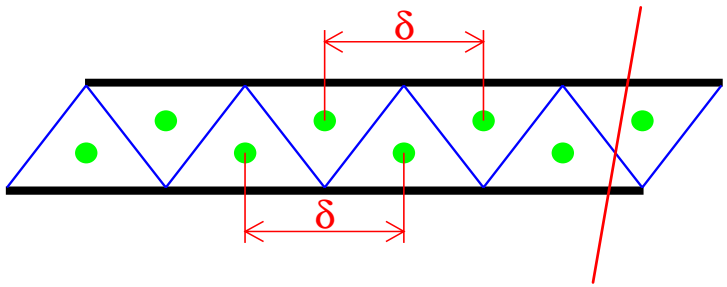
Dr. Huang is now a postdoc in CDF with Duke University

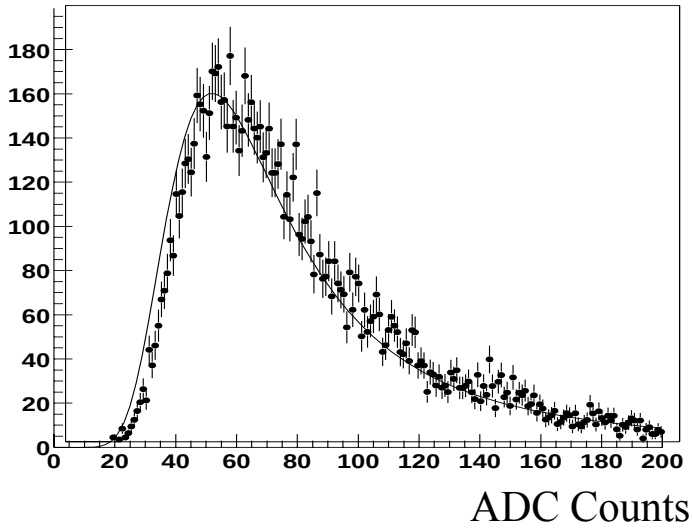
Central Preshower Detector

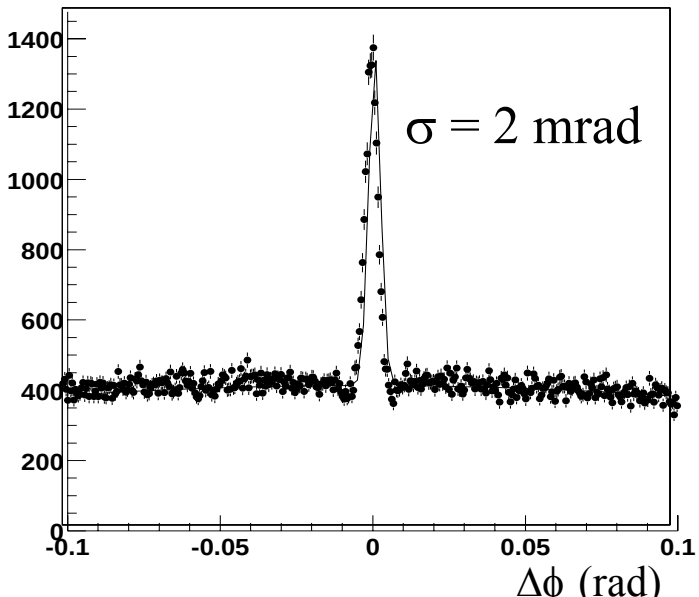
Designed, constructed, installed and to be operated by our group !

Central Preshower Detector







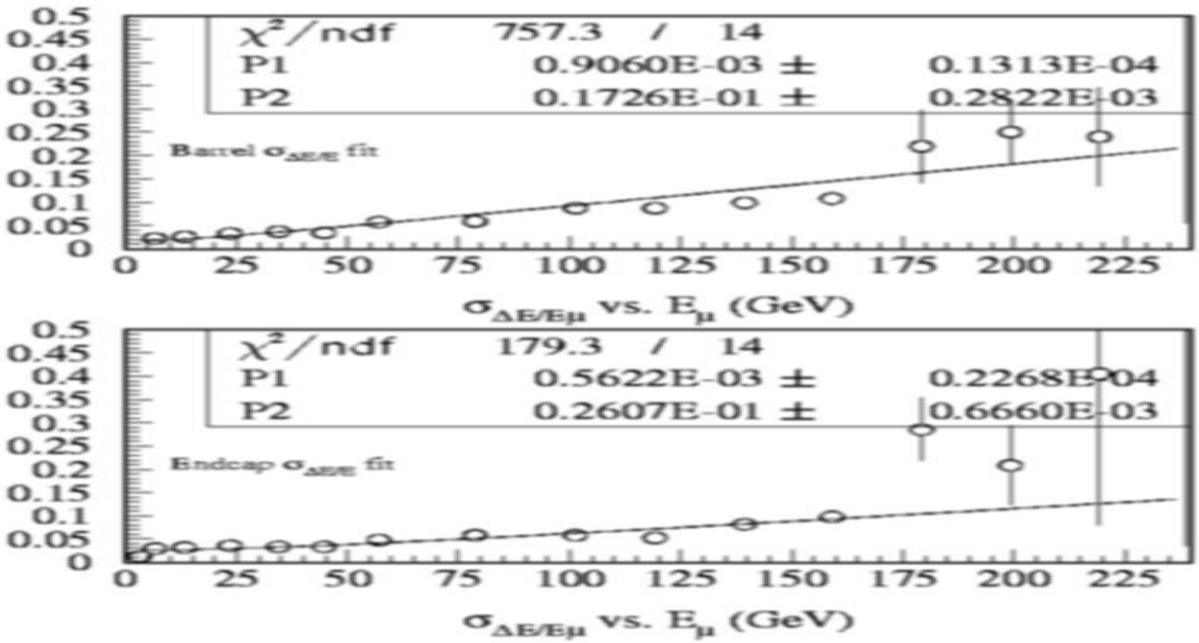


- **All layers instrumented**
- **Operated as a tracking detector now**
- **MIP peak clearly measured**
- **Very precise position resolution**

Fast Muon MC Program

Develop a fast and accurate MC muon package for DØ Run II Physics

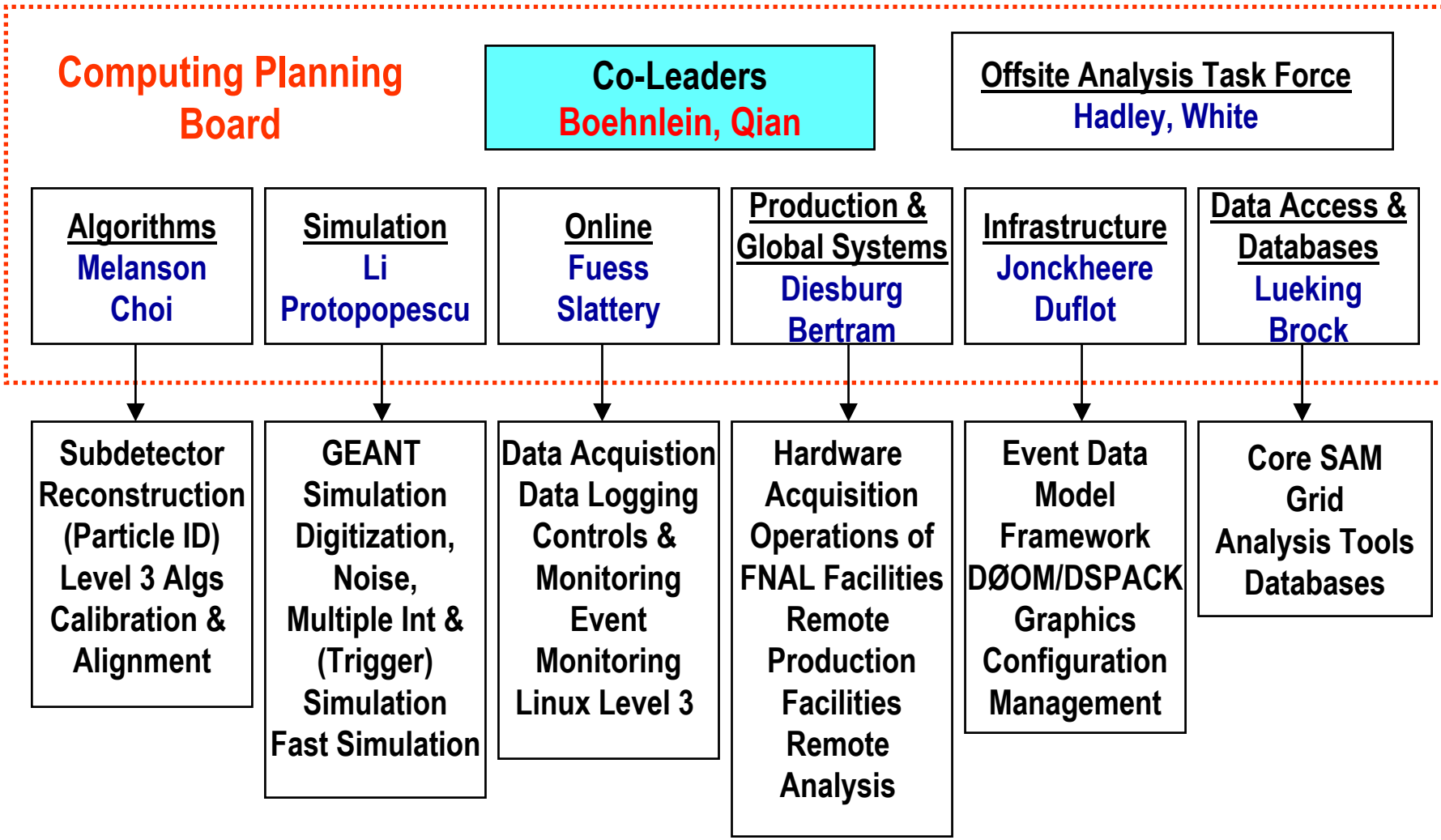
- **Full detector simulations and reconstructions**
- **Parameterizations of the muon detector performance**
- **Parameterizations of local and global muons**
- **Comparisons between fast and full (slow) simulations**



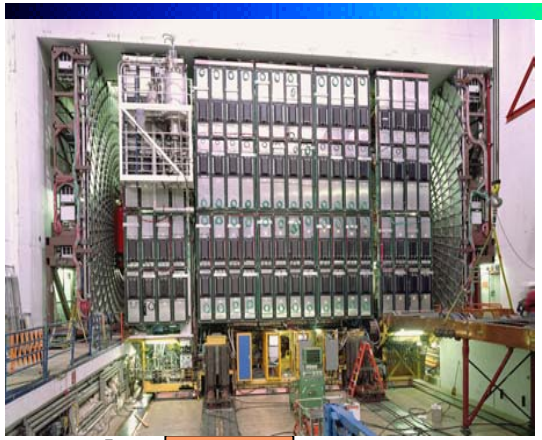
Further work: tune the fast simulation program using data

Top Quark Physics

Computing & Software

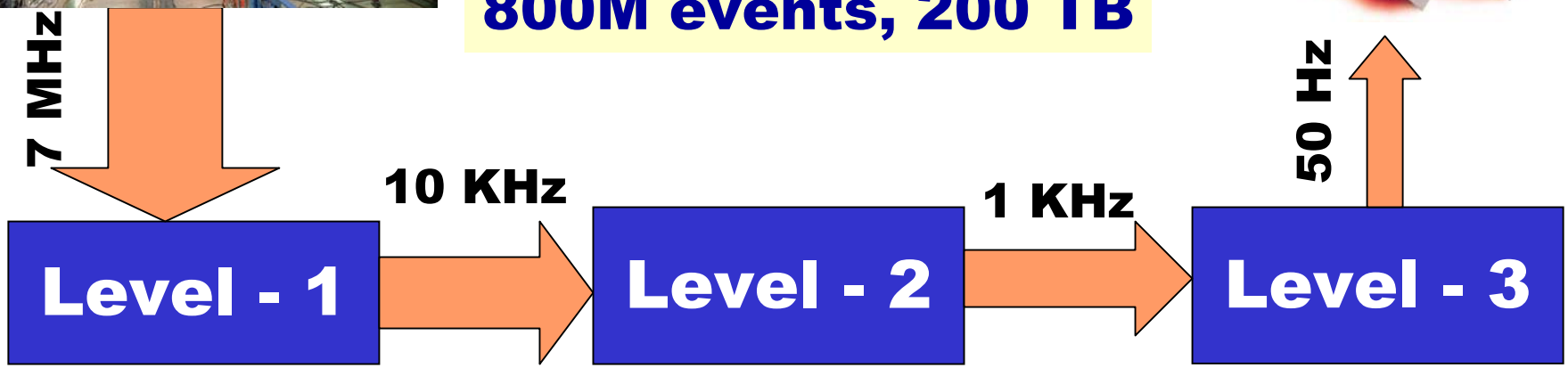


Event Rate & Size



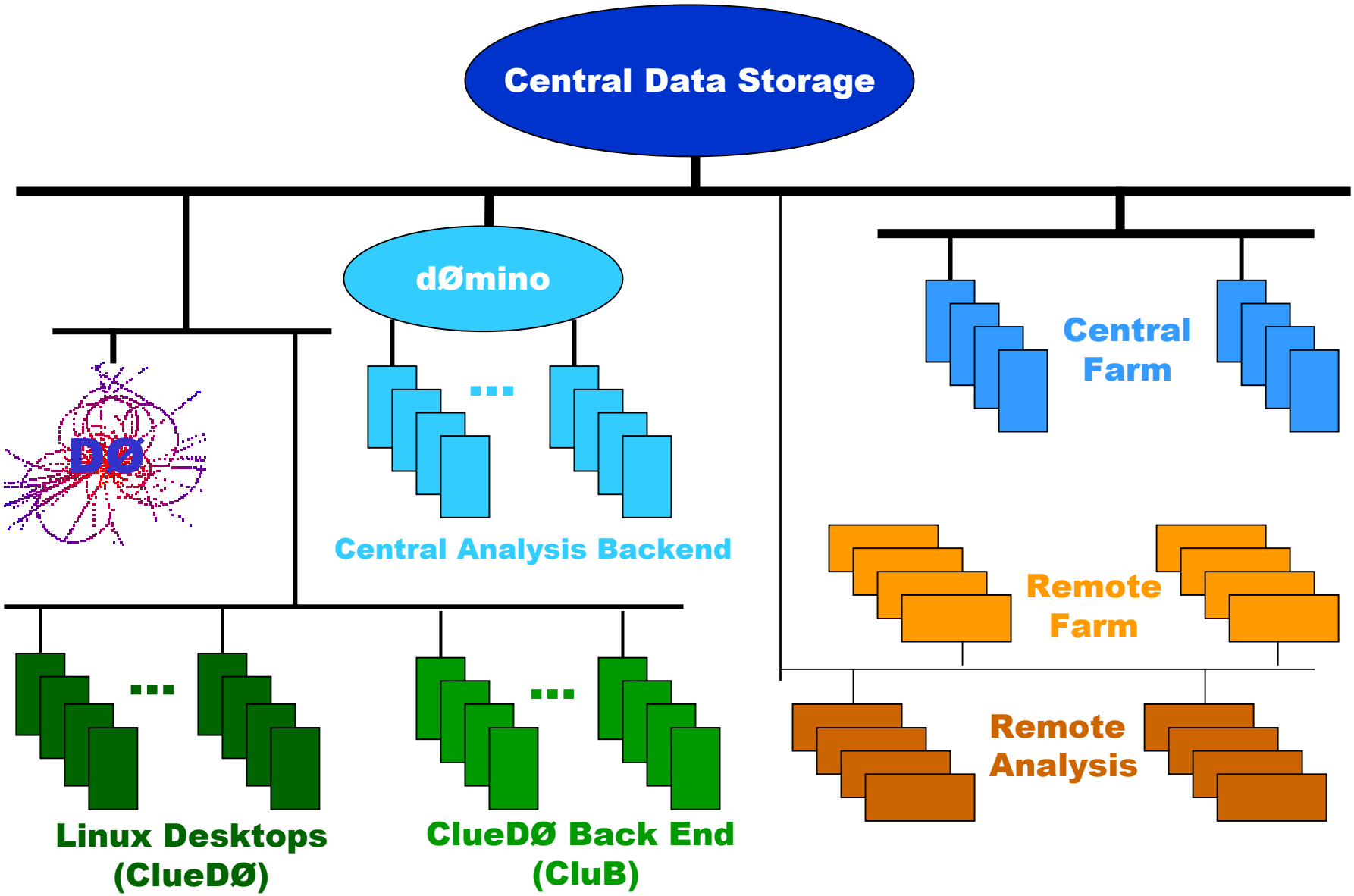
In a Second:
25 events, 6.3 MB

In a Year:
800M events, 200 TB



- ~ 7,000,000 collisions per second, most of them are "uninteresting"
- successive hardware and software algorithms to select interesting events for offline analyses

Computing Architecture



Data Production Farm

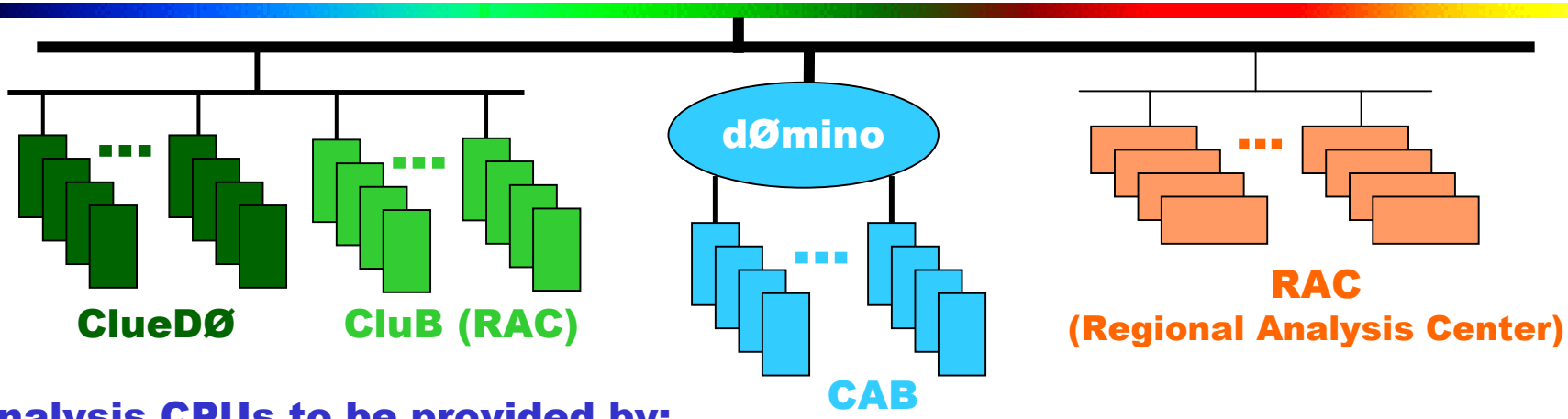
- A PC/Linux based farm has been deployed at Fermilab to perform initial processing of the raw data
  - Currently the farm has 122 dual processors with a total 0.186 THz CPU power, soon to be augmented with 240 new dual processors with a total CPU power of ~1.15 THz
  - The current farm cannot keep up with the data-taking. Will catch up with the 240 new nodes expected to be in production in October
- However, there won't be enough CPU power available for secondary processing that may be required for timely physics analyses

We hope to meet some of this need with the CPU power from collaborating institutions (such as Michigan)

Monte Carlo Production

- Simulation of detector responses and physics processes is an integral part of our physics analysis effort.
- To meet the analysis needs, Monte Carlo events have to be produced at ½ of the rate of the data events.
- There is no resource available at Fermilab for Monte Carlo production.
- Remote Monte Carlo farms have been meeting our physics analysis needs so far.
  - Current sites: Boston, CCIN2P3, Lancaster, NIKHEF, Prague, UTA, …
- The total capacity of the existing farms is ~ 3 Hz. We are
  - developing a fast simulation program for some of the analyses
  - seeking new sites to increase our production capability

Analysis Model



Analysis CPUs to be provided by:

- **Central Analysis Backend (CAB) at Fermilab:**
  A PC/Linux dØmino back-end supplied and administrated by the computing division
- **ClueDØ/CluB at DØ:**
  Linux PCs contributed mostly by institutions for interactive and batch jobs.
- **Regional Analysis Centers (RAC):**
  Institutions with CPU, disk and personnel resources to serve collaborators.

Layered Analysis Approach:

- **DST stripping:**
  Resource intensive, limited to physics, and detector groups, done at CAB
- **TMB based:**
  Medium resource required, expect to be done mostly by subgroups at RACs
- **Derived datasets:**
  Individuals done daily on their desk/lap tops

Where We Are Now

All building blocks are in place …

- PC/Linux based Level-3 is taking a 500 Hz input and the DAQ is capable of writing at ~50 Hz.
- The offline reconstruction program (DØRECO) has all the basic reconstruction functionalities, is deployed at all farms, and writes DØRECO output in a temporary format.
- Data processing is done at Fermilab. The central farm is capable of processing event at ~6 Hz DC (40 sec/event on a 500 MHz processor) .
- Monte Carlo needs of physics analyses are met by remote farms (Czech R., France, G. Britain, Netherlands, USA)
- Geant-based (slow) and parameterized (fast) simulation programs exist and are being refined.
- Basic infrastructures and functionalities of data handling and access are in place. Data are stored in the Enstore system via SAM.
- Analysis CPUs are provided by an SGI O2000 system (dømino) and Linux desktops (ClueDØ, …).

… we are producing first physics results!

Where We Want to Go

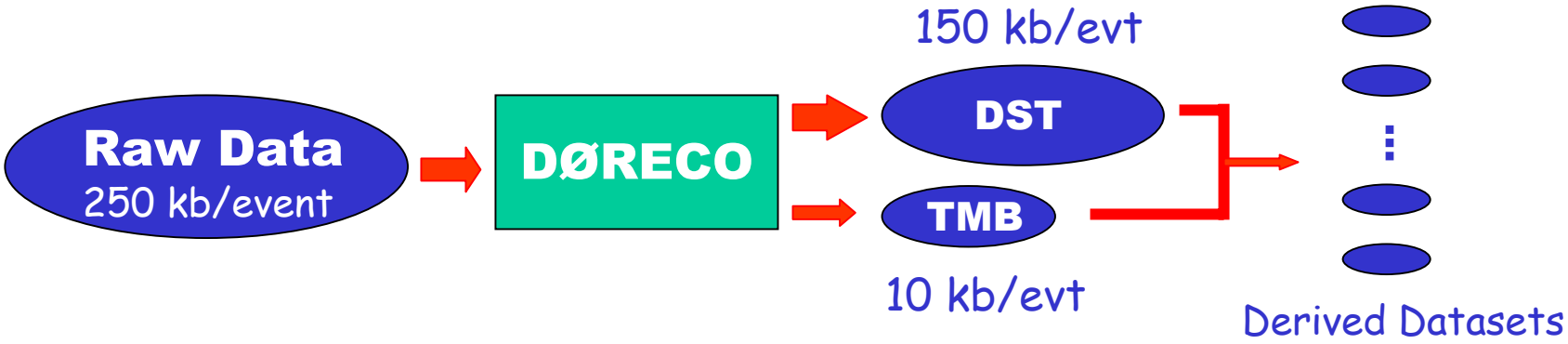
- An Level-3 capable of taking 1 kHz input and a DAQ capable of writing at ~50/100 Hz for Run IIa/IIb.
- A DØRECO running at a reasonable speed, writing out reconstructed information in both DST and TMB formats.
- A central Fermilab farm capable of keeping up with the online and providing some reprocessing CPU power.
- Simulation programs provide reasonable descriptions of real data.
- A reliable and fast data handling and access system capable of providing full TMB and partial DST datasets to all analysis centers.
- A global system capable of producing Monte Carlo events at ½ of the data rate and providing secondary data processing.
- An analysis model of central and regional centers with sufficient CPU and disk resources to meet analysis needs.
- An automatic and tiered software release system serving all production and analysis centers as well as individual institutions.
- ...

Summary & Plan

- Operate and Calibrate the Central Preshower Detector
- Coordinate DØ Computing and Software Effort
- Pursue Run II Physics (top quark, Higgs, new phenomena)
- Establish a DØ processing site using NPACI resources

We are making critical contributions to the DØ Experiment

Data Tier



- **DST (Data Summary Tape):**
  all high level physics objects, some detector-level information to allow calibration and limited re-reconstruction.
  100% on tape, partial set on disk.

- **TMB (Thumbnail):**
  all high level physics objects, good for most physics analyses,
  100% on tape, 100% on disk at central and regional centers.

- **Derived Datasets:**
  Physics/ID groups or their subgroups may create their derived datasets from either DST or TMB in their chosen format and are responsible for maintaining these datasets.